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Using Producer and Consumer Subsidy Equivalents in the SWOPSIM Modeling Framework

Stephen L. Haley

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Abstract

Producer subsidy equivalents (PSE's) and consumer subsidy equivalents (CSE's) are used as aggregate policy measures in the U.S. Department of Agriculture's (USDA) modeling of the effects of trade liberalization on world agriculture. This report examines some issues concerning the use of PSE's and CSE's in the modeling of agricultural trade liberalization in the context of the Static World Policy Simulation (SWOPSIM) models of USDA. It discusses some of the assumptions required when using PSE's and CSE's in SWOPSIM, the possible shortcomings of those assumptions, and alternative ways of dealing with the shortcomings. Three related topics are: (1) using PSE's and CSE's as approximations to specific policy interventions such as target prices, loan rates, and export restitutions, (2) adjustments to PSE's when modeling acreage set-asides and/or supply controls, and (3) initialization of the model in the context of distortions.

Keywords: producer subsidy equivalent, consumer subsidy equivalent, economic model, trade liberalization

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Using Producer and Consumer Subsidy Equivalents in the SWOPSIM Modeling Framework

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Introduction

Producer subsidy equivalents (PSE's) and consumer subsidy equivalents (CSE's) are important in the Economic Research Service's (ERS) modeling of the effects of trade liberalization on world agriculture. The PSE is a measure of the amount of income that a producer would have to be compensated for the removal of government support under current programs and at current prices. Likewise, the CSE is a measure of the amount of income that a consumer would have to be compensated for the removal of government support. PSE's and CSE's are aggregate measures of support representing the degree to which a particular agricultural commodity sector is influenced by direct government involvement.

This report examines the use of PSE's and CSE's in the modeling of agricultural trade liberalization in the context of the static world policy simulation (SWOPSIM) models of ERS (3).[1] A primary issue is the use of PSE's and CSE's as price wedges in modeling the effects of distortions on agricultural production, consumption, and trade. Three particular topics are: (1) using PSE's and CSE's as approximations to specific policy interventions such as target prices, loan rates, and export restitutions, (2) adjustments to PSE's when modeling acreage set-asides and/or supply controls, and (3) initialization of the model in the context of distortions.[2]

Trade Modeling in SWOPSIM Framework

ERS researchers are responsible for the trade liberalization modeling work within USDA. The primary modeling work has been in the construction of a world policy model of trade called the trade liberalization (or TLIB) model. The purpose of the model is to analyze probable effects of liberalization resulting from the Uruguay Round of multilateral trade negotiations under the auspices of the General Agreement on Tariffs and Trade (GATT). The TLIB data base consists of 22 commodities and comprises 36 countries/regions. Livestock commodities include: beef and veal (BF), pork (PK), mutton and lamb (ML), poultry meat (PM), poultry eggs (PE), milk (DM), butter (DB), cheese (DC), and dairy skim powder (DP). The crops include: wheat (WH), corn (CN), rice (RI), other coarse grains

[1] Underscored numbers in parentheses refer to items in the References.
[2] There are many methodological issues in measuring PSE's and CSE's. For a concise discussion, see (4), especially pages 20-28.

(OG), soybeans (SB), other oilseeds (OS), cotton (CT), sugar (SU), and tobacco (TB). Other commodities include: soybean meal (SM), soybean oil (SO), other oilseed meals (OM), and other oilseed oils (OO).

The TLIB model has been constructed in the SWOPSIM modeling framework. Models created by the SWOPSIM procedure are located in spreadsheets and are modified and solved as spreadsheets. They are characterized by an economic structure that includes constant elasticity supply and demand equations and summary policy measures. Trade is the difference between supply and demand. Stockholding behavior is not explicitly modeled. The policy measures used in the model are PSE's and CSE's compiled by ERS (5). The PSE's and CSE's form price wedges which separate world commodity prices from domestic producer and consumer prices. Liberalization scenarios consist in removing these wedges and then observing the effects on production, consumption, trade, prices, and other important economic variables.

There are a variety of technical issues involved in measuring PSE's and CSE's. Because they are aggregate measures of support, the effects of many types of distortionary policies must be combined. Table 1 is produced from information in a recent ERS publication (5). It shows examples of policies that are typically included in PSE estimates. Construction of the estimates relies on government budget data, and on price gap data for market price support policies. Another ERS publication shows specifically how PSE's and CSE's were calculated by ERS analysts for 1982-86 (4). These estimates form the basic support data base for the TLIB model.

An essential aspect of PSE's and CSE's is that they are measures based on an income compensation principle. The individual components are not weighted by their effects on either production or consumption. This specification implies that individual components comprising the PSE or CSE are perfect substitutes. Although this specification may be appropriate for certain contexts, it can present problems when one uses the PSE and CSE as a model price wedge. For instance, a dollar spent on a direct payment to a producer is assumed to have the same effect on production as a dollar spent on an input subsidy or on research and extension. The perfect substitutability assumption, if valid, is valid only over a fairly long time horizon. The use of the PSE/CSE is most suited to the examination of the effects of liberalization over a 5- to 7-year time interval after the liberalization. Furthermore, model results based on the use of PSE's and CSE's indicate tendencies rather than explicit predictions. More confidence should be placed on the direction of changes rather than precise magnitudes.

Two general areas are of interest in a liberalization scenario: (1) how are supply, demand, trade, prices, and producer income affected, and (2) how do resources adjust to a more liberalized trading environment? The TLIB model is designed to answer the first question based on elasticities and other parameters used in the model, but is silent on the second question. One way to partially remedy the deficiency is to include inputs in the model specification. Although the inclusion of input sectors can be accommodated in the SWOPSIM modeling framework, this inclusion has not been completed. However, even if inputs were included, the model would still be describing a transition over a 5- to 7-year time horizon to a new static world equilibrium. The path of resource adjustment would still be missing. Furthermore, any structural change that might cause model parameters (that is, elasticities) to change would by necessity be missing. Structural change would presumably be a longer term response to trade liberalization.

Table 1--Examples of policies included in PSE estimates

Market price support:

- Domestic price supports linked with border measures (quotas, permits, tariffs, variable levies, and export restitutions)
- Tariffs and export taxes
- Two-price systems and home consumption schemes
- Price premiums (often used for fluid milk)
- Domestic price supports linked with production quotas
- CCC inventory and commodity loan activities
- Marketing board price stabilization policies
- State trading operations

Direct income support:

- Direct payments -- deficiency, disaster, direct storage, headage and acreage diversion, PIK entitlements, stabilization payments, and other direct government payments
- Producer coresponsibility levies (negative support)

Programs affecting variable costs of production:

- Fertilizer subsidies
- Fuel tax exemptions
- Concessional domestic credit for production loans
- Irrigation subsidies
- Crop insurance

Programs affecting marketing of commodities:

- Transportation subsidies
- Marketing and promotion programs
- Inspection services

Programs affecting long-term agricultural production:

- Research and extension services
- Conservation and environmental programs
- Structural programs

Controlled exchange rates:

- Fixed rates
- Differential rates
- Crawling-peg rates

Given its limitations, the TLIB model should not be the only tool for evaluating the effects of trade liberalization. Other models and approaches (including the insights of commodity analysts) may yield equally valuable insights. In some cases, it may be that results from TLIB could provide input into other models that model aspects left implicit in TLIB. Examples might include the effects of trade liberalization on land use patterns, rural income distribution, rural-urban migration, agricultural capital formation, and other similar concerns.

The next two sections of this report examine the modeling of specific U.S. and European Community (EC) policies in SWOPSIM.

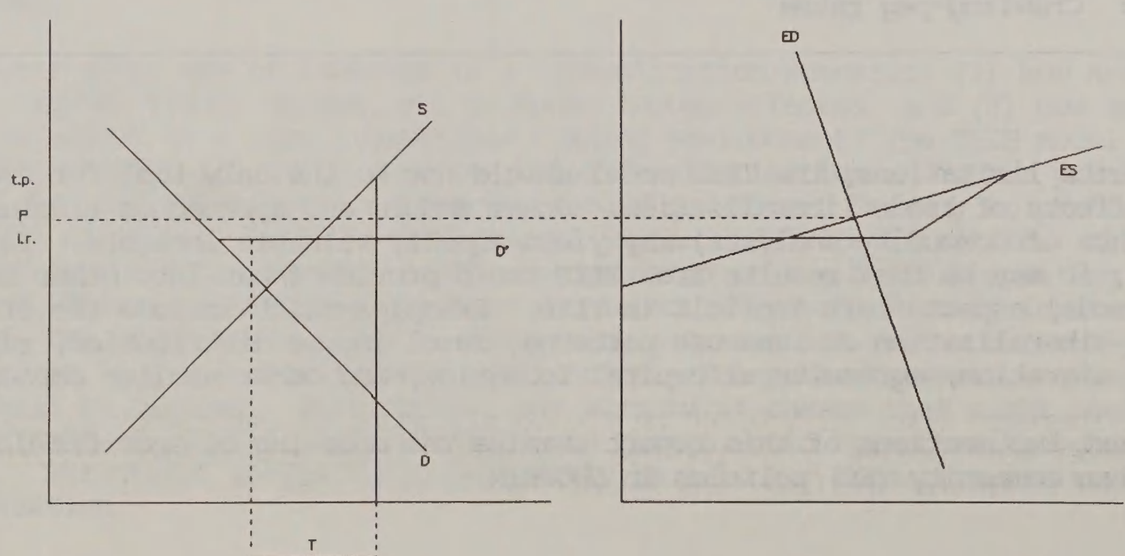
Target Prices, Loan Rates, and Set-Asides

Deficiency payments for various crops are a part of the U.S. PSE. A deficiency payment is a direct payment equal to the difference between the U.S. target price and the higher of the average U.S. market price for the first 5 crop year months or the U.S. loan rate. Payments are restricted to producers who choose to abide by the provisions of the government support program. The primary program requirement is that a certain proportion of a producer's base acreage be taken out of production of the program commodity. Participants have access to nonrecourse loans provided by the Commodity Credit Corporation (CCC). They have the option of receiving the loan rate amount for each unit of production they enter into CCC stocks. If they have not redeemed their loan at the end of a 9-month period, producers can effectively cancel their debt by forfeiting the grain to the CCC. When market prices are depressed, that is, when they fail to rise appreciably above the loan rate, CCC-owned stocks tend to accumulate as producers choose to forfeit their grain as repayment of the loan they received.

SWOPSIM does not directly model the target price and loan rate concepts. Rather, it incorporates the transfers implied by the operation of the programs into a PSE price wedge. It is possible that some comparative static effects implied by SWOPSIM in a modeling scenario will differ from other models which more directly model target prices and loan rates. The remainder of this section graphically compares the modeling approaches.

Figure 1 shows one way to model the effect of target prices and loan rates on trade. The left panel shows the domestic market for a commodity. Ordinary (that is, Marshallian) supply and demand curves show how the market works with no government program. The horizontal difference between the supply and demand curves defines the excess supply curve in the right panel. Rest of world (ROW) buying behavior is captured in the downward sloping excess demand curve. The intersection of the excess supply and demand curves fixes the equilibrium world price (P) for the commodity. With a loan rate program, producers can receive a nonrecourse loan equal to "l.r." in the left panel. If producer participation in the program is 100 percent, then the demand curve becomes perfectly elastic at the loan rate (curve D'). The deficiency payment scheme renders the original

Figure 1--Target price and loan rate

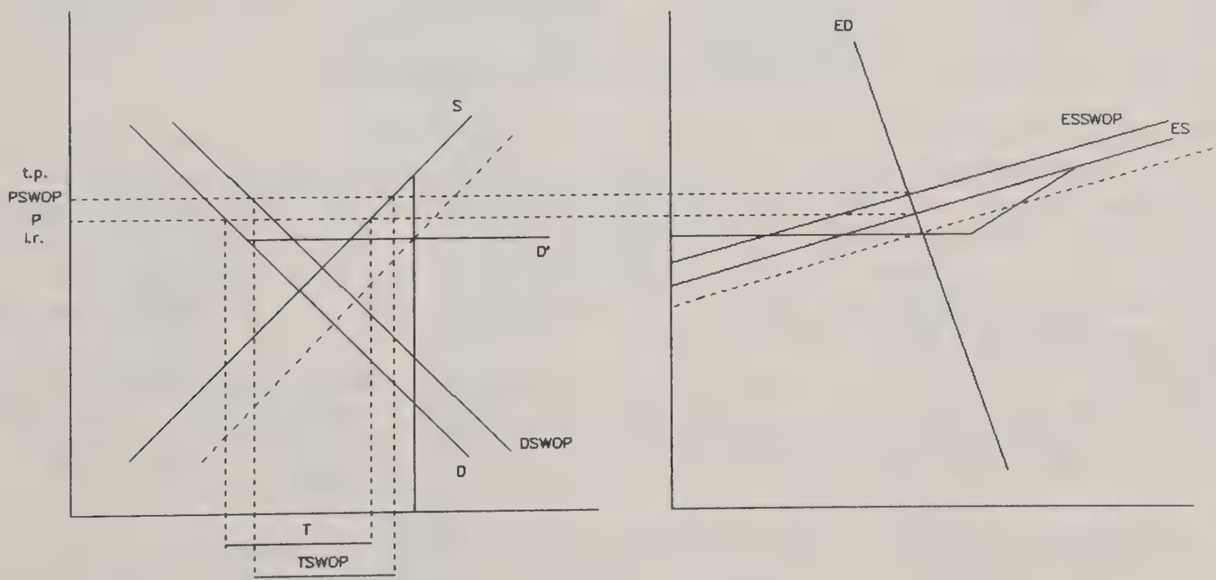


supply curve irrelevant for prices below the target price (t.p.).[3] Whatever the market price, producers respond to the target price so the effective supply curve is perfectly inelastic up to the target price. For prices above the target price, the original supply curve describes producer response behavior.

The effective excess supply curve no longer corresponds to the original curve in the right panel. It now consists of three distinct parts. The first part, perfectly elastic, shows that at the loan rate producers either market their products or enter it into public stocks. The quantity traded depends on the positioning of the ROW excess demand curve. In the figure, the distance from the vertical axis to the intersection point corresponds to the distance "T" in the left panel. The second portion of the curve describes trading behavior between the loan rate and the target price. As the world price increases within this range, increases in the quantity traded come from reductions in domestic consumption. Because the producer's incentive price is the target price, the world price increase does not affect individual production decisions. The slope of the excess supply curve within this range is the absolute value of the slope of the demand curve. The third portion of the curve describes trading behavior above the target price. The producer's incentive price now equals the world price. The original excess supply curve once again becomes the effective supply curve.

SWOPSIM has two problems when modeling the target prices and loan rates. First, SWOPSIM generally uses PSE's and CSE's as price wedges to account for the effect of policies. The perfectly inelastic supply curve which captures the target price effect is not modeled. Instead, the unit value of the deficiency payment becomes part of the price wedge separating the true supply curve and the subsidy-laden supply curve parallel to it. In figure 2, this curve is shown as

Figure 2--Target price and loan rate in SWOPSIM



[3] There is limit of $50,000 on the total amount of deficiency payments that a producer can receive in a crop year. However, there are ways of circumventing this limit. In what follows, the assumption is made that the producer is infinitely creative in avoiding the limit.

the dashed curve lying below the supply curve. In this example, it is assumed that the deficiency payment constitutes the entire PSE. If the initial price is at the loan rate, the quantity supplied is determined from the dashed curve, but the incentive price necessary to induce producers to supply this quantity is read from the real supply curve. As can be seen in the figure, the incentive price is equal to the target price and the quantity supplied is the same amount supplied as seen in figure 1.

SWOPSIM's second problem is a technical one. Because it is a spreadsheet-based model, it is not convenient to model with discontinuities in supply or demand curves. The problem is one of how to model stocking behavior. The solution is to hold constant the flow into stocks in a liberalization scenario. The SWOPSIM demand curve will differ from the true demand curve if there is stocking behavior. In figure 2, because there is a positive flow into public stocks, the SWOPSIM demand curve (that is, DSWOP) lies to the right of D by the flow amount.

The SWOPSIM excess supply curve lies parallel to the true curve in the right panel. It emanates from the vertical axis at the price coordinate where the subsidy-laden curve intersects DSWOP in the left panel. The excess supply curve intersects the excess demand curve so that the world price equals the U.S. loan rate as in figure 1.

In a full liberalization scenario, all price wedges are removed. In figure 2, the excess supply curve shifts upward to ESSWOP and the new world price equals PSWOP. New quantities supplied and demanded are determined where the new world price line intersects S and DSWOP, respectively. The new quantity traded is represented as TSWOP in the left panel. For the alternative modeling method (that is, the one with the kinked curves), the liberalized excess supply curve is ES. Its intersection with the excess demand curve at P determines production, consumption, and trade (T). PSWOP is higher than P because SWOPSIM assumes a fixed flow into stocks. With less available on the world market, the price response is slightly higher. DSWOP can be shifted back exogenously to compensate for the stocking assumption. If no shift correction is made, however, the errors in production and consumption tend to cancel each other out with regard to trade. (T and TSWOP are roughly equal.)

Figure 3 shows the modeling of acreage set-asides with a target price but no loan rate (or the loan rate is ineffective). S1 is the initial, effective supply curve and ES1 is the effective excess supply curve. The initial world price is PINT, determined where ES1 and ED intersect. In the SWOPSIM approach, the dashed curve farthest from but parallel to S in the left panel is the initial subsidy-laden supply curve. It is drawn so that it intersects the PINT line at the quantity level implied by S1. The dashed curve in the right panel is the initial SWOPSIM excess supply curve. If a set-aside requirement is put in place, the effective supply curve shifts leftward from S1 to S2. The excess supply curve correspondingly shifts from ES1 to ES2. The quantity traded is reduced to T in the left panel, and the world price is increased to P.

With the SWOPSIM approach, the set-aside is modeled as an imposition of a producer tax. In the left panel, the subsidy-laden supply curve shifts up by the unit value of the tax. In the right panel, the excess supply curve shifts upward to ESSWOP. The intersection of ED and ESSWOP determines the new SWOPSIM world price (PSWOP). Because SWOPSIM does not capture the inelastic effect of domestic supply with a target price, its excess supply curve is more elastic than ES1 or ES2. The effect on world price is therefore less. New production, consumption, and trade (TSWOP) levels are seen in the left panel. SWOPSIM

implies more production and consumption than the alternative modeling approach. Predicted new trade levels, however, are less likely to differ significantly.

Figure 4 shows the set-aside when there is an effective loan rate program. D1 in the left panel is the effective demand curve. It is perfectly elastic at the loan rate (l.r.). DSWOP represents the SWOPSIM demand curve adjusted for flows into public stocks. The set-aside requirement shifts domestic supply from S1 to S2. Excess supply in the right panel shifts from ES1 to ES2. ES2 intersects ED at the loan rate; there is no change in the world price. The implication is that the set-aside has no effect on trade (T2); it reduces the flow into public stocks on a one-to-one basis. With SWOPSIM, the excess supply curve shifts upward from ESSWOP to ES as implied by the upward shift of the subsidy-laden

Figure 3--Target price and set-aside

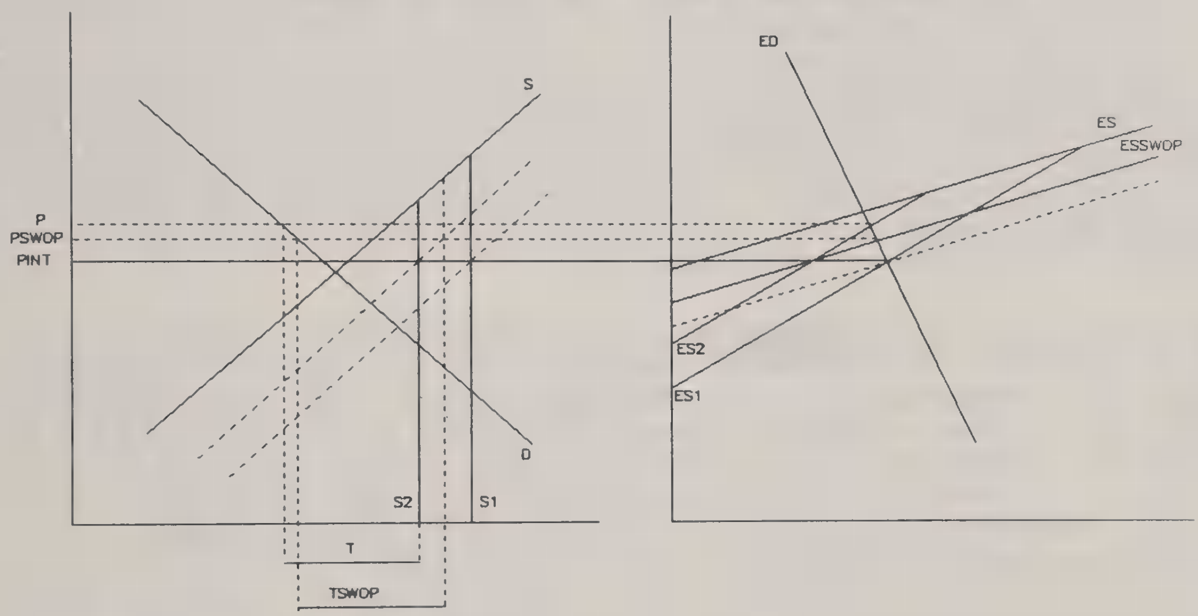
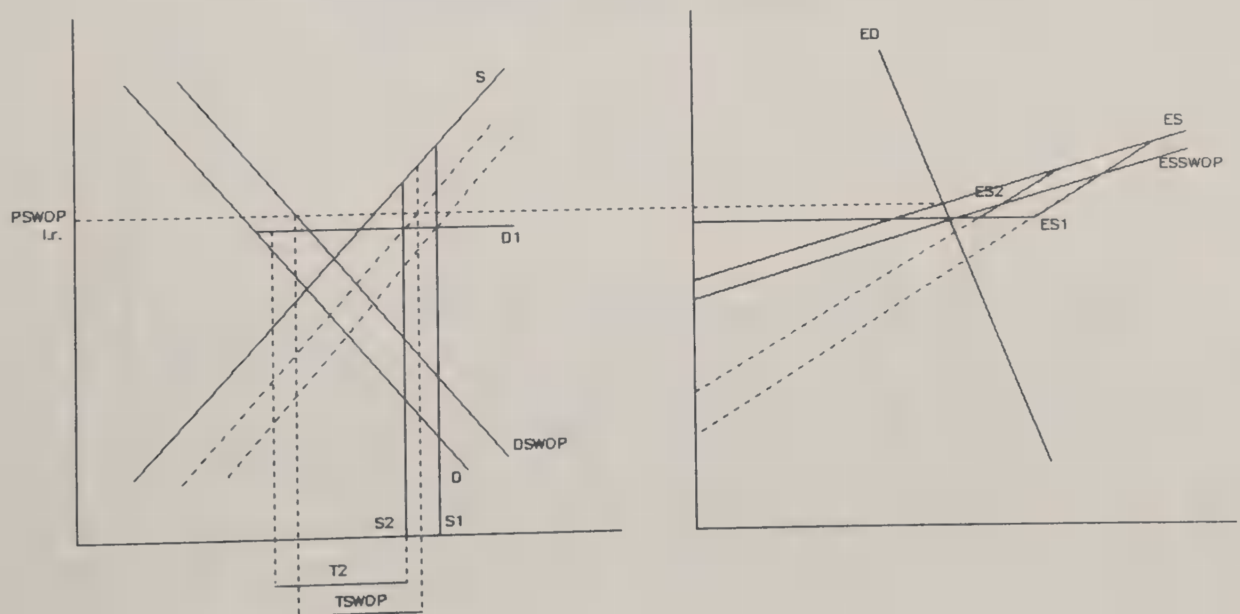


Figure 4--Target price, loan rate, and set-aside



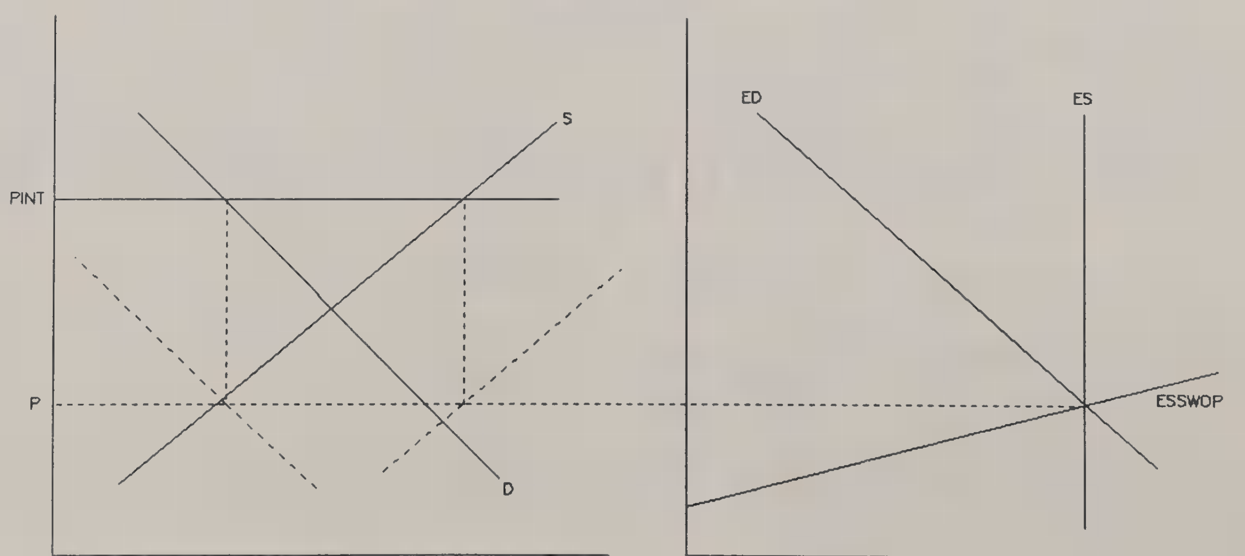
supply curve in the left panel. Because the public stock flow is held constant in SWOPSIM, the set-aside affects trade and causes the world price to increase to PSWOP. The higher world price causes a feedback effect of increased production relative to S2 and lower consumption. Although the world price effect acts to expand trade, it is unlikely to fully offset the implied SWOPSIM set-aside effect of reduced trade. TSWOP, therefore, overstates the effect on trade of a set-aside when the world price remains close to the loan rate.

Export Restitutions and Variable Levies

The EC uses both export restitutions and variable levies to insulate its grain sector from disturbances in the world market. The policy instruments are similar. Imports enter at the threshold price which is set higher than the domestic purchase price. Domestic output is, therefore, less expensive than imports. The difference between the threshold price and the world price is the variable levy. As world prices change, the variable levy adjusts to maintain the threshold price. Regardless of international disturbances, domestic output retains its cost advantage over imports. For exports, the difference between the minimum producer sales price (the intervention price) and the world price constitutes the export restitution or subsidy. Changes in world excess demand do not affect EC prices because the unit restitution adjusts automatically to maintain the intervention price. The EC, therefore, exports its excess production on the world market regardless of changes in the world price and of its effect on international competitors.

Export restitutions and variable levies are modeled within SWOPSIM. Figure 5 shows how an export restitution is modeled. S and D represent EC supply and demand curves, respectively, for a particular product. The intervention price is set at PINT. The difference between PINT and the world price P is the export restitution. Because PINT is assumed to be held constant, EC production and consumption are fixed and the EC excess supply curve (ES) is perfectly inelastic. SWOPSIM treats the export restitution as a positive PSE and negative CSE whose unit absolute values are equal to each other. Under normal circumstances, the EC SWOPSIM curve would appear as ESSWOP. However, ESSWOP does not capture the endogenous component of the restitution. Figure 6 shows the PSE/CSE adjustment when ROW excess demand shifts rightward and establishes a

Figure 5--Export restitutions

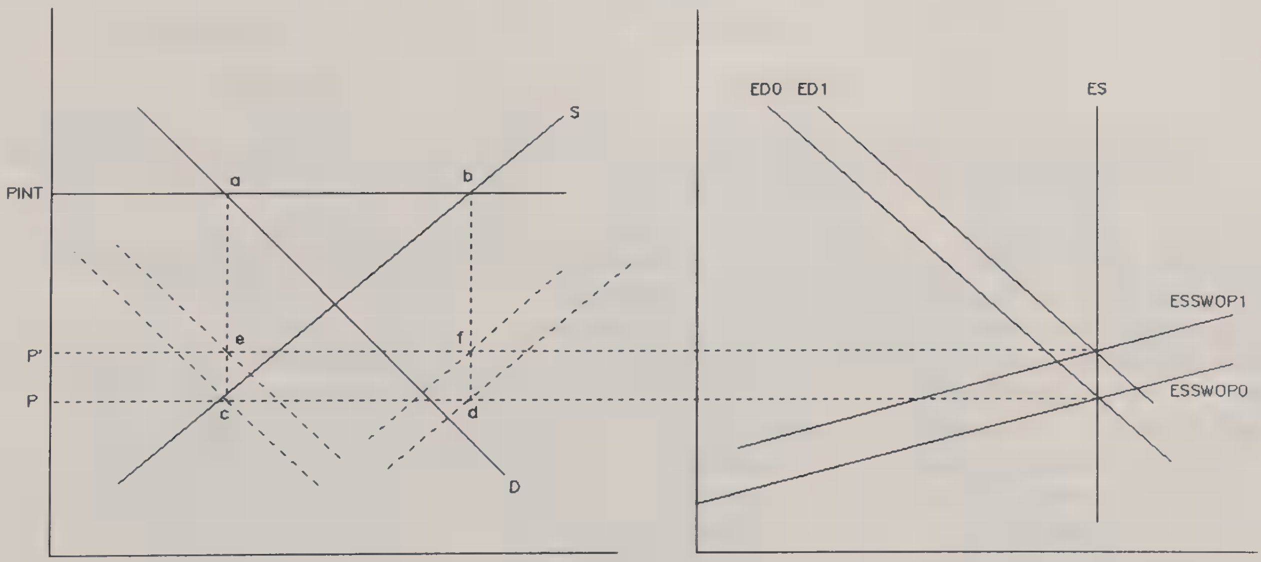


new world price of P'. If the intervention price remains unchanged, the EC supplies the same quantity to the world market, but its restitution is reduced by (P'- P). To capture this adjustment, ESSWOP shifts upward by (P'- P) to ESSWOP1. Total EC expenditure on restitutions (shown in the left diagram) is reduced from abdc to abfe. The way to model this type of policy within SWOPSIM is to specify a price transmission elasticity of zero. The zero elasticity specification does not permit price changes from the world market to affect EC domestic prices. EC budget expenditure rather than domestic production and consumption adjusts to international commodity disturbances.[4]

Figure 7 shows two full liberalization alternatives. In both cases, the EC removes all support to the product. If the intervention price concept is maintained (but is set equal to the new world price), the effective EC excess supply curve is ES' rather than ESSWOP'. The domestic market is still insulated from international disturbances although export restitutions have been reduced to zero.

Attention must be paid to the way in which the policies are reformed. This phenomenon is especially relevant in the context of partial liberalization where a subset of policies is changed whose effect on production may be different than the subset not changed. The PSE/CSE framework cannot differentiate the effects of differing policies without input from the analyst. Table 2 shows a 50-percent EC wheat liberalization under two conditions. The first has a wheat

Figure 6--Export restitutions and excess demand changes



[4] Setting a price transmission elasticity to a number less than one effectively endogenizes the setting of PSE's and CSE's in a model region. In various TLIB scenarios where not all countries are liberalizing, analysts have specified that nonliberalizing countries react to world price changes resulting from the liberalization by allowing only a fraction of the price changes to filter to their domestic markets. As an alternative to using price transmission elasticities, one could endogenize PSE or CSE formation more directly by inserting a formula in the SWOPSIM world spreadsheet which specifies the level of the PSE or CSE as a function of some condition imposed by the analyst. See (3), pages 25-27, for examples illustrating the logic behind this procedure.

Figure 7--Export restitutions and liberalization

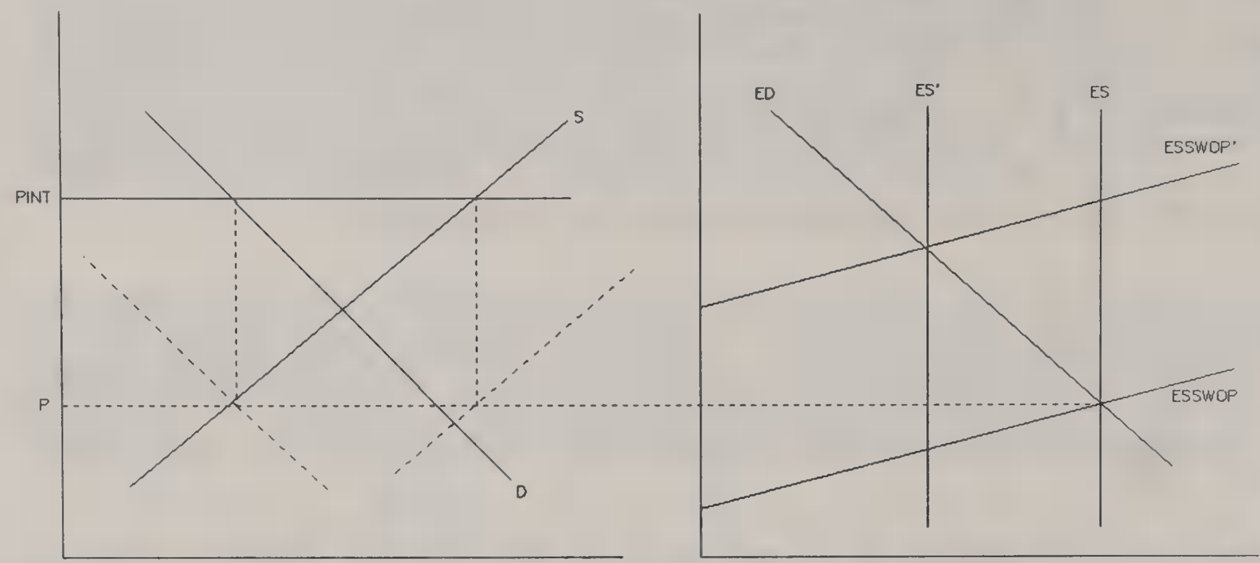


Table 2--Price transmission and 50-percent EC wheat liberalization

Transmission elasticity	World price	EC price	EC production	EC net trade
	--- Dol./mt ---		--- 1,000 mt ---	
1	124.43	138.01	61,747	-117
0	125.97	131.60	60,120	-2,589

transmission elasticity equal to 1 and the second has an elasticity equal to zero. The initial EC producer price of wheat is $184.60 and the value of the subsidy wedge removed equals $53. With a zero transmission elasticity, the new producer price is ($184.60 -$53) or $131.60. The EC becomes a net wheat importer of 2,589,000 metric tons. Alternatively, if the price transmission elasticity equals 1, then the higher world price due to reduced excess supply drives up the domestic EC producer price to $138.01. Net imports fall to 117,000 metric tons. Therefore, assumptions regarding price transmission can affect the model solution. In a partial liberalization, the type of policy being removed and the ones left in place need to be considered.

Supply Control, PSE Adjustment, and Welfare

Supply controls in the United States usually take the form of acreage reduction requirements. A certain percentage of a producer's base acreage must be taken out of production or set-aside to qualify for participation in government support programs. In TLIB, there is no explicit distinction between farm program participants and nonparticipants. TLIB uses various slippage coefficients to calculate what production would have been had there been no set-

aside requirement. An area adjustment factor represents the likely proportion of set-aside land that would come back into production with removal of the program. This area is further adjusted by a planted-to-harvested factor. Then yields are adjusted to reflect the addition of less productive set-aside land and to reflect the less intensive use of the land which had not been set aside.[5]

The effect of the set-aside requirement can be modeled as an implicit tax on producers which reduces production.[6] Modeling the set-aside this way is the same as the modeling of a production quota. Figure 8 illustrates the case of a set-aside requirement and a PSE in a small country.[7] S is the undistorted supply curve. With no set-aside, quantity supplied equals Qs, and the producer incentive price equals P+PSE. Q0 is the quantity supplied with the supply control. The supply curve becomes kinked at Q0 (curve "S'"). The tax equivalent of the set-aside equals the difference between the incentive price with no set-aside (P+PSE) and the price coordinate associated with the kink.[8]

The tax can be easily calculated as long as the effect of the set-aside on production can be calculated.[9] Let h represent the ratio of the set-aside effect on production to what production would have been with no set-aside program. Further, let p represent the producer price of the commodity; c, the own price supply elasticity; and a, a constant. The supply equation relating initial production (Q0) to price is:

$$Q0 = (1 - h)*a*p^{c} \qquad (1)$$

If one uses a tax equivalent (tax) to model this relationship, then the equation is written:

$$Q0 = a*(p - tax)^{c} \qquad (2)$$

---

[5] See (2) for a full discussion of the set-aside problem in the SWOPSIM modeling framework. This report reviews the literature concerning the estimation of slippage effects associated with set-aside programs. It also details the procedures that TLIB users have employed to incorporate set-asides into trade liberalization analysis.

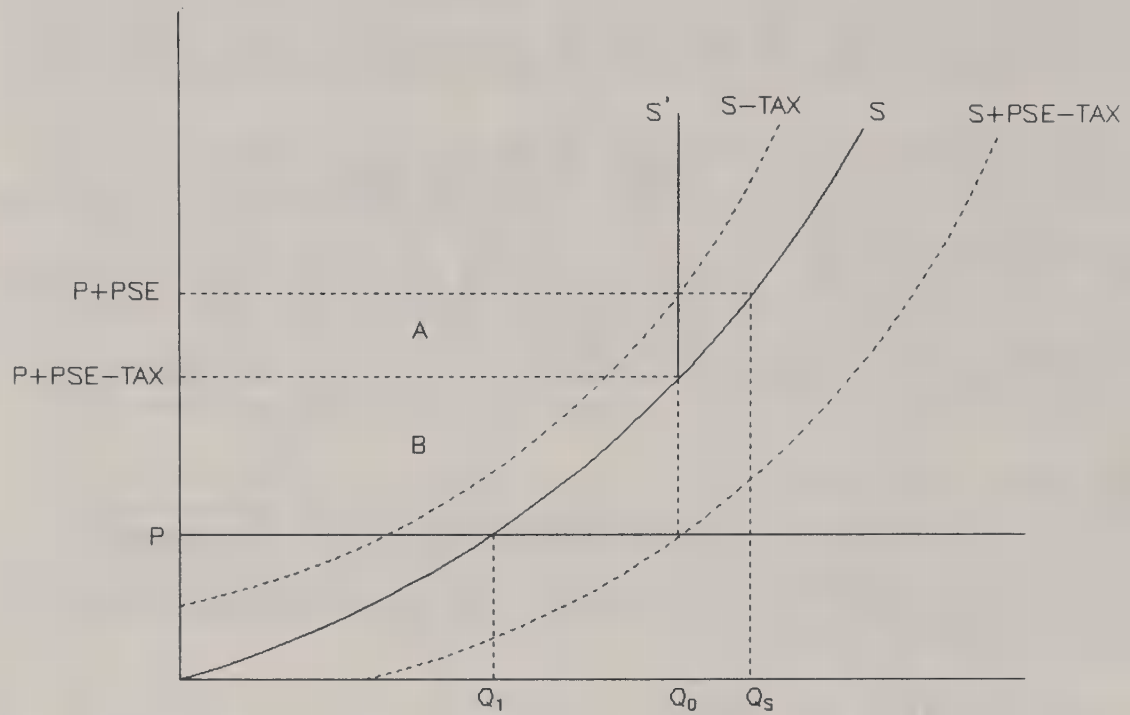
[6] In the current version of TLIB, removal of the set-aside is modeled as a supply curve shift. As explained below, the shift factor is equivalent to the removal of the tax described in this section. Welfare results depend on the tax equivalents regardless of the modeling of the set-aside removal.

[7] In this context, the small country assumption means that the world price of the commodity is not significantly affected by the country's set-aside policy. However, this assumption may not be fully justified for the United States or for Japan for rice. In equation 1, the tax could change the world price of the set-aside commodity, and thus partially offset the tax effect on domestic production. To incorporate this feedback effect, one needs to know the ROW excess demand elasticity. This elasticity, however, is not a constant: it varies according to the type of scenario being modeled. The precise value of the tax would have to be calculated within the model solution. Given that removal of the set-aside is likely to be an element of trade liberalization, precise calculation of the tax is not practical. The small country approximation of the tax is used instead.

[8] The incentive price need not equal (P+PSE). As discussed below, an incentive price in TLIB can be the market price adjusted upward by the unit value of direct payments or the market price plus the PSE less market support.

[9] See footnote #5 for the reference on how this is done in the TLIB model.

Figure 8--Supply control



Setting the equations equal to each other, and solving for tax produces:

$$tax = p*(1 - (1 - h)^{\frac{1}{e}}) \qquad (3)$$

The price wedge which accounts for distortionary government policies is equal to the PSE less the tax. In the figure, simultaneously removing the PSE and the set-aside shifts production from Q0 to Q1.

The price at which supply is initialized should be the incentive price less the amount of the tax. In the figure, this position is at the point at which the supply curve is kinked, that is, at (P+PSE-TAX). Any return greater than this amount does not affect production and should be interpreted as a form of economic rent. The change in producer surplus resulting from trade liberalization will equal the sum of A and B in the figure. "A" represents the rental loss due to the removal of the set-aside. "B" represents the customary loss in producer surplus when there is a reduction in the producer price of a product.

Table 3 shows producer surplus changes for various set-aside commodities for the United States and Japan.[10] The first column shows the producer loss due to the removal of the supply-restricting policies. These numbers correspond to area A in the figure. The second column shows the ordinary producer loss due to a lower producer price. These numbers correspond to area B. Most of the producer loss for U.S. wheat, corn, and rice can be attributed to the loss of rent associated with the set-aside policies. The choice of a differing base year in which the set-aside requirement was not as high could produce very different

[10] These results are from the scenario in which prices are initialized using the full PSE/CSE component added to the traded price.

Table 3--Changes in producer surplus for set-aside commodities

Country/commodity	Rent	Producer loss without rent	Producer loss
		Million U.S. dollars	
United States:			
Wheat	2,525	411	2,936
Corn	3,923	625	4,548
Coarse grains	226	897	1,123
Rice	426	306	732
Cotton	739	1,088	1,827
Japan:			
Rice	5,829	10,909	16,738
Wheat	-188	561	373
Coarse grains	-189	423	234
Soybeans	-321	902	581

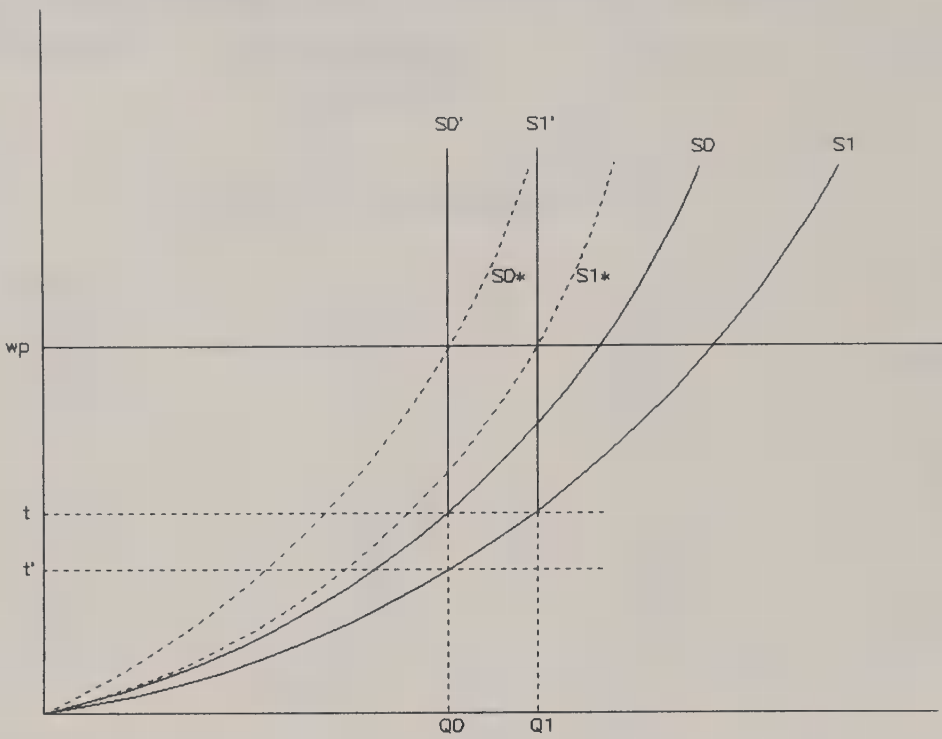
welfare results.[11] The Japanese Paddy Field Reorientation Program (PFRP) moves land out of rice production and into the production of other crops such as wheat, coarse grains, and soybeans. These latter crops are treated as though they receive a subsidy (or negative tax) in order to generate the additional quantity supplied due to the PFRP.

Cross-Compliance Requirements

Set-aside programs often require that land taken out of production of one commodity cannot be used to produce other commodities covered by the program or perhaps other nonprogram commodities. This restriction on land use is referred to as cross-compliance. If a cross-compliance requirement is in effect, then the tax equivalent of the set-aside described above must be revised. Figure 9 shows a wheat set-aside for this situation for a small country. S0 is the original supply curve. A set-aside is in place. All else constant, production is reduced to Q0. The new supply curve is S0', while the SWOPSIM supply curve is S0*. S0* is separated from S0 by the tax equivalent of the set-aside. In the figure, the tax equivalent is equal to difference in the world price (wp) and t. If the set-aside program covers another commodity (corn, for instance) and if no restriction is placed on the use of the land taken out of corn production, then that land could be used to expand wheat production. In the figure, the wheat supply curve shifts from S0' to S1'. The goal of a cross-compliance would be to restrict this expansion. In SWOPSIM, an additional tax equal to (t - t') would have to be used to compensate for the shift from S0' to S1'.

[11] The ordinary producer surplus loss is also relatively smaller because the world prices of the listed commodities increase as a result of trade liberalization. In the figure, the world price line labeled as "P" shifts upward and thereby reduces area B.

Figure 9--Set-aside and cross compliance



The new tax can be derived by examining the equations implicit in figure 9. S0* is the desired SWOPSIM supply curve for wheat which yields the desired level of production of Q0. If the set-aside requirement applied to only wheat, equation 4 would represent S0*:

$$Q0 = A*P_c^{-e}*(P_w - TAX0_w)^d \tag{4}$$

where TAX0 is the tax equivalent, "w" and "c" are subscripts corresponding to wheat and corn, respectively, "A" is an exogenous shift parameter, "d" is the own price supply elasticity, and "e" is the corn cross-price elasticity. If the set-aside were applied to corn with no cross-compliance requirement, S0* would shift rightward to S1*. With the cross-compliance requirement, the relevant supply curve is still S0*, but S0* must be defined to take account of the shift factor:

$$Q0 = A*(P_c - TAX_c)^{-e} *(P_w - TAX_w)^d \tag{5}$$

where TAX_w is the wheat tax equivalent with cross-compliance, and TAX_c is the corn tax equivalent. Equations 4 and 5 can be set equal to each other and solved for TAX_w:

$$TAX_w = P_w - (P_w - TAX0_w)*\left(\frac{P_c - TAX_c}{P_c}\right)^{\frac{e}{d}} \tag{6}$$

As can be seen, the wheat tax equivalent is a function of the corn tax equivalent in addition to the original wheat tax equivalent. Therefore, it is necessary to simultaneously compute the corn tax equivalent:

$$TAX_C = P_C - (P_C - TAX0_C) * \left(\frac{P_W - TAX_W}{P_W} \right)^{\frac{g}{f}} \qquad (7)$$

where "f" is the own price corn elasticity and "g" is the wheat price cross-price elasticity.

Figure 10 shows the spreadsheet calculation of TLIB set-aside tax equivalents for the United States and Japan. The top part of the spreadsheet shows the calculations for the United States; the middle part shows the tax formulas corresponding to the U.S. tax equivalents; and the bottom part shows the set-aside calculations for Japan.

There are five U.S. commodities directly affected by the set-aside program: wheat, corn, other coarse grains, rice, and cotton. Rows 4-8 show information relevant for the ordinary set-aside tax calculation when there are no cross-compliance requirements. Column H shows the tax and column I shows the price at which initialization should take place (that is, PRPRICE - TAX0). Rows 16-18 show information relevant for the tax calculation involving cross-compliance for the program commodities. Rice and cotton are not included because the current model parameters imply that land used to grow these commodities is not likely to be used for the production of wheat, corn, or other coarse grains. Column G shows the cross-compliance taxes and column H shows the initial model prices. Rows 24-26 show the tax equivalent effect of cross-compliance on the nonprogram commodities of soybeans, other oilseeds, and sugar. These commodities are being implicitly taxed because land taken out of the program commodities cannot be used to expand their acreage. Column H shows the tax.

The wheat, corn, and other coarse grain set-aside tax equivalents increase by 38, 44, and 180 percent, respectively, when cross-compliance is incorporated. The tax equivalents for soybeans, other oilseeds, and sugar were zero before incorporating cross-compliance.

Although cross-compliance taxes will influence model results, the effect may not be large or significant. The cross-compliance requirement has kept production below what it would have been without the restriction (hence, the notion of a tax equivalent). A liberalization scenario involving lifting of the cross-compliance requirement should show increased production and exports and lower world prices. As an experiment, the cross-compliance taxes were placed into the TLIB model. A full industrialized market economies trade liberalization scenario was run. Table 4 shows a comparison between this run and a run without the taxes incorporating cross-compliance. With the exception of cotton and rice, U.S. production and exports are slightly higher. With the exception of cotton, the world price of each commodity is lower. Producer returns for the program commodities are lower. For the most part, however, providing for cross-compliance does not seem to dramatically change implications of the TLIB exercise.[12]

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[12] If more inelastic supply elasticities are used in the model, the tax equivalent of the set-aside (with or without cross-compliance) becomes much larger. In this case, production and price results can be much more dramatic. Therefore, the effect of set-asides will often be judged by one's notion of underlying supply elasticities.

Figure 10--Set-aside tax equivalent calculations

U.S. SET-ASIDE TAX CALCULATIONS

	A	B	C	D	E	F	G	H	I
1	ST86-US	ACREAGE	ACREAGE	SLIPPAGE	SSHIFT	PRELAST	PRPRICE	TAX0	INITIAL
2		HRVSTED	SET-ASIDE	(HAR/PLNT)					PRICE
3		(1000 AC)	(1000 AC)						
4	WHEAT	60700	20400	0.86	.2117298	0.6	15	42	110
5	CORN	69189	13600	.89	.1097706	.48	91	18	73
6	OGRAINS	32771	4500	.92	.0480183	.6	69	5	64
7	RICE	2380	1271	.99	.1413043	.4	325	91	234
8	COTTON	8357	3300	.92	.1661130	.74	1907	358	1549
9									
10									
11									

12 CROSS-COMPLIANCE REQUIREMENT:PROGRAM COMMODITIES

13

14		TAX0	PRPRICE	WHEAT	CORN	OGRAIN	TAX	INITIAL
15								PRICE
16	WHEAT	42	152	.6	.25	.06	58	94
17	CORN	18	91	.11	.48	.01	26	65
18	OGRAIN	5	69	.16	.04	.6	14	55
19								
20								
21								

22 CROSS-COMPLIANCE REQUIREMENT:PROGRAM COMMODITIES

23		PRPRICE	OWN	WHEAT	CORN	OGRAIN	COTTON	TAX
24	SOYBEAN	171	.6	0	.15	.03	.11	15
25	OOILSEED	240	.55	.16		.09	.08	45
26	SUGAR	274	.5	.06				15
27								
28								
29								

30 SUMMARY

31			INITIAL
32	PROGRAM	TAX	PRICE
33			
34	WHEAT	58	94
35	CORN	26	65
36	OGRAINS	14	55
37	RICE	91	234
38	COTTON	358	1549
39			
40	NON-PROGRAM		
41			
42	SOYBEAN	15	171
43	OOILSEED	45	240
44	SUGAR	15	274

Continued--

TAX FORMULA CODES

```
H1       = "   TAX0 (NO CROSS COMPLIANCE)
H4       = G4*(1-(1-(E4/(1+E4)))^(1/F4))
H5       = G5*(1-(1-(E5/(1+E5)))^(1/F5))
H6       = G6*(1-(1-(E6/(1+E6)))^(1/F6))
H7       = G7*(1-(1-(E7/(1+E7)))^(1/F7))
H8       = G8*(1-(1-(E8/(1+E8)))^(1/F8))

G14      = "    TAX (CROSS COMPLIANCE: PROGRAM COMMODITIES)
G15  I   = C15-(C15-B15)*(((C16-G16)/C16)^(E15/D15))*(((C17-G17)/C17)^(F15/D15))
G16  I   = C16-(C16-B16)*(((C15-G15)/C15)^(D16/E16))*(((C17-G17)/C17)^(F16/E16))
G17  I   = C17-(C17-B17)*(((C15-G15)/C15)^(D17/F17))*(((C16-G16)/C16)^(E17/F17))

H22      = "     TAX (CROSS COMPLIANCE: NON-PROGRAM COMMODITIES)
H23      = B23*(1-(((C16-G16)/C16)^(E23/C23))*(((C17-G17)/C17)^(F23/C23)))
H24      = B24*(1-(((C15-G15)/C15)^(D24/C24))*(((C17-G17)/C17)^(F24/C24))*
           (((G8-H8)/G8)^(G24/C24)))
H25      = B25*(1-(((C15-G15)/C15)^(D25/C25)))
```

JAPAN SET-ASIDE TAX CALCULATIONS

	A	B	C	D	E	F	G	H	I
50									
51	ST86-JP	HECTARE	HECTARE	SLIPPAGE	SSHIFT	PRELAST	PRPRICE	TAX0	INITIAL
52		HRVSTED	SET-ASIDE	(HAR/PLNT)					PRICE
53									
54	WHEAT	246	-72	1	-.293	.52	1443	-1366	2809
55	OGRAINS	108	-36	1	-.333	.55	1260	-1374	2634
56	RICE	2303	618	1	.268	.5	2274	860	1414
57	SOYBEAN	138	-75	1	-.543	.7	2667	-6244	9911

Modeling Set-Asides through Supply Curve Shifts

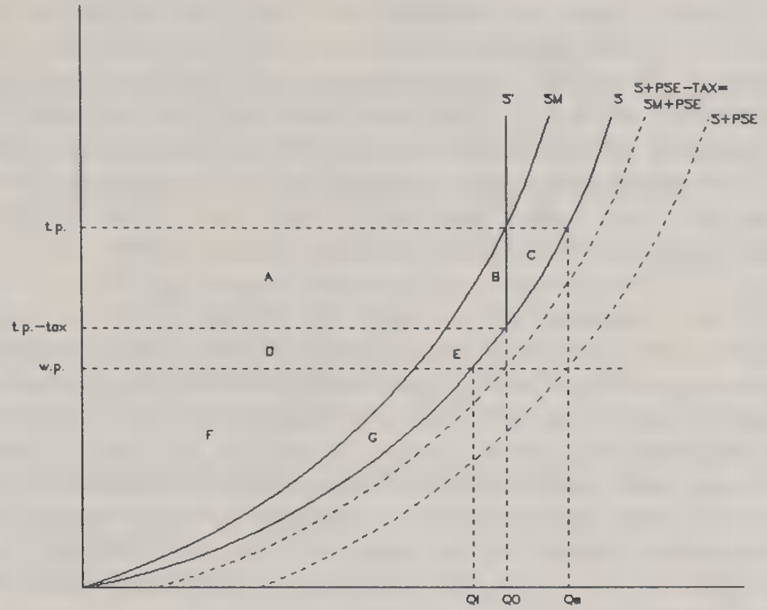
An alternative way to model a removal of a set-aside is to directly shift the supply curve. In figure 10, these shifts, corresponding to the program commodities in rows 4-8, are in column E. A key advantage to shifting the curves directly is the easy interpretation of what the removal of a set-aside means for increased production. The tax equivalent of a set-aside, on the other hand, may not be as transparent.

The shift approach is contrasted with the tax equivalent approach in figure 11. The true supply curve is S. With government support programs and no set-aside provision, the subsidy-laden supply curve is S+PSE. The quantity supplied is determined where S+PSE intersects the world price curve at Qs. The price on the supply curve which yields this amount is the target price (t.p.). If participation in a set-aside program becomes mandatory for receipt of government support, Q0 represents the new quantity supplied. The tax equivalent of the set aside ("tax") is the amount by which the subsidy-laden supply curve must be shifted back to yield Q0. The incentive price which yields Q0 is (t.p.-tax). The shift method of modeling the set-aside forces the supply curve to shift to

Table 4--Comparison of model results with and without cross-compliance

Commodity	TLIB with no cross-compliance	TLIB with cross-compliance	Percentage difference
	--------- Dol./mt	---------	Percent
World price:			
Wheat	151.31	147.99	-2.2
Corn	108.19	104.82	-3.1
Coarse grain	101.15	99.23	-1.9
Rice	263.35	262.52	-.3
Cotton	1,188.30	1,190.98	.2
Soybeans	212.61	204.23	-3.9
Other oilseeds	371.63	363.77	-2.1
Sugar	184.91	184.21	-.4
	--------- 1,000 mt	---------	
U.S. production:			
Wheat	53,776	56,306	4.7
Corn	203,089	206,272	1.6
Coarse grain	33,351	34,494	3.4
Rice	3,528	3,520	-.2
Cotton	1,741	1,648	-5.3
Soybeans	52,909	53,814	1.7
Other oilseeds	7,100	7,637	7.6
Sugar	2,750	2,804	2.0
	--------- 1,000 mt	---------	
U.S. net exports:			
Wheat	24,782	27,231	9.9
Corn	39,170	41,183	5.1
Coarse grain	-4,067	-3,020	25.7
Rice	1,975	1,965	-.5
Cotton	1,092	1,068	-2.2
Soybeans	21,031	21,646	2.9
Other oilseeds	1,264	1,779	40.7
Sugar	-6,110	-6,053	.9
	--------- $ million	---------	
U.S. producer surplus:			
Wheat	-3,532	-3,693	-4.6
Corn	-5,548	-6,228	-12.3
Coarse grain	-1,155	-1,300	-12.6
Rice	-777	-744	4.2
Cotton	-1,484	-1,511	-1.8
Soybeans	-516	-200	61.2
Other oilseeds	-8	236	3,050.0
Sugar	-871	-815	6.4

Figure 11--Set-aside and supply curve shift



	SHIFT	TAX EQ.
INITIAL PRODUCER SURPLUS	A+D+F	A+B+D+E+F+G
NEW PRODUCER SURPLUS	F+G	F+G
CHANGE	G-(A+D)	-(A+B+D+E)

SM. The incentive price is t.p. Under both methods, liberalization implies production at Q1 and a producer price of w.p.

The primary difference between the approaches lies in the welfare calculations. With the shift method, the preliberalized producer surplus is (A+D+F). These areas correspond to the usual calculation method for producer surplus. The producer cost of the set-aside program equals (B+C+E+G). With the tax equivalent method, the preliberalized producer surplus is (A+B+D+E+F+G). The tax equivalent method treats area (A+B) as a decoupled transfer because unit payments above (t.p.-tax) do not increase production. The producer cost of the set-aside program in this instance equals area C. Unlike the shift method, the tax equivalent method assumes that producers withdraw only the most unproductive land from production.[13] The shift method assumes land of average quality is withdrawn instead.

The total change in producer surplus for the shift method is (G-(A+D)). The change for the tax equivalent method is -(A+B+D+E). Both methods agree that producers lose (A+D), but differ by (B+E+G). The shift method assumes that removal of the set-aside brings back into production land of average quality (a gain of (B+E+G)), but the loss of deficiency payments nets out (B+E), leaving a partial gain of area G to be added to the loss of (A+D). The tax equivalent method shows a gain of area C to the removal of the set-aside, but the loss of deficiency payments subtracts out area C along with (A+B+D+E).

[13] Relatively unproductive land is distinguished by higher marginal costs as production is increased incrementally. Because the supply curve is defined as marginal cost curve above the average variable cost curve, withdrawing marginal land from production implies movement down the supply curve rather than a leftward shift in the supply curve.

Without revising the way in which producer surplus is calculated within SWOPSIM, the choice of methods depends on the assumption that one wants to make regarding the quality of land taken out of production due to the set-aside. Table 5 highlights a TLIB scenario in which both methods are used. The top part of the table shows that liberalized world prices are practically the same regardless of the method. The bottom part of the table shows the producer surplus for the program commodities.[14] As expected, the tax equivalent producer loss exceeds the loss calculated by the shift method. The difference (B+E+G) is shown in the third column. The difference for both wheat and corn is over a billion dollars.

As mentioned earlier, the advantage of the shift method is the ease of interpretation of removing the set-aside on production. As long as one makes changes to the producer surplus calculations within SWOPSIM, the shift method could be used while still assuming that marginal land is withdrawn from production due to the set-aside provisions. Target prices would serve as producer incentive prices instead of being adjusted by what might be interpreted as "less-than-transparent" tax equivalents. Because communication of model results to a more general audience is the goal of the SWOPSIM modeler, the shift approach may be preferable as long as the proper producer surplus revisions are made within the model.[15]

Table 5--Comparison of tax equivalent and supply shift

Commodity	Set-aside modeled as tax equivalent	Set-aside modeled as supply shift	Absolute difference
		Dol./mt	
World price:			
Wheat	147.99	148.08	0.07
Corn	104.82	105.29	.47
Coarse grain	99.23	99.44	.19
Rice	262.52	262.56	.04
Cotton	1,190.98	1,181.44	-9.54
Soybeans	204.23	205.14	.91
Other oilseeds	363.77	365.43	1.66
Sugar	184.21	184.42	.21
		$ million	
U.S. producer surplus:			
Wheat	-3,693	-2,683	1,010
Corn	-6,228	-4,847	1,381
Coarse grain	-1,300	-1,102	198
Rice	-744	-649	95
Cotton	-1,511	-1,229	282

[14] Producer surplus for nonprogram commodities, although not shown in the table, tend to be fairly close to each other, as one would expect.

[15] As of November 1988, the default producer surplus formulas within SWOPSIM have been revised to incorporate the effect of the tax equivalents on welfare.

This discussion should not obscure empirical difficulties associated with accounting for the quality of land withdrawn to satisfy set-aside requirements. The aggregation level of a model like TLIB is very high. Assumptions underlying aggregation imply representative producers who respond to a set-aside requirement by withdrawing their most unproductive land from production. The assumption of the representative producer facilitates the approach taken to welfare analysis. A potentially serious complication may arise when one confronts the highly variable distribution of land quality across the United States. For example, two participating producers with land endowments differing in quality may withdraw the same percentage base acreage of marginal quality from crop production, but the quality of the set-aside land could be substantially different. Another way of saying this is that land withdrawn in a highly productive area could have a higher potential for production than land withdrawn in another area. The kinked supply curve representation of the set-aside may, therefore, understate the welfare gain. Additional producer gains may result as more highly productive land than what was assumed in the welfare calculation comes back into production. In figure 11, the removal of a set-aside with no other policy removal for a small country would imply a welfare gain of C. The assumption of land of average quality coming back into production would imply a gain of (B+C+E+G). Although the true change in producer surplus falls somewhere between the two extremes, TLIB assumes that is closer to C alone rather than (B+C+E+G).

Price Initialization

SWOPSIM uses the unit values of the PSE and CSE as model price wedges. A liberalization scenario consists of removing the price wedge and letting the model reach a new equilibrium. Equivalently, the removal of the price wedge could be modeled as a supply and/or demand curve shift. For supply, the shift factor (SSHIFT) would equal the following:

SSHIFT = 1 - ((PRPRICE - PSE)/PRPRICE)^(SUPPLY ELASTICITY)

The amount by which the supply curve shifts depends on the initial price (PRPRICE). The use of a lower initial price magnifies the effect of the removal of the PSE. Therefore, an analyst must be careful when selecting prices at which to initialize the model. The selection of inappropriate prices could bias the results of the liberalization exercise.

One method of initialization is to adjust the market producer price of a commodity by the unit value of direct payments.[16] The reasoning is that all components of the PSE except the direct payments are reflected in the market price of the commodity. The addition of the unit value of direct payments reflects the producer's incentive price when making a production decision. Adaption of this initialization scheme implicitly recognizes that the components of the PSE cannot be simply summed with no adjustments being made to reflect the differing effect of each component on production. The same reasoning applies to consumption.

Table 6 shows the initialization and some of its effects in the U.S. beef sector in an early version of TLIB. For production, the difference between the initial price and the traded price is defined as "prconst." For consumption, the

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[16] This initialization scheme was used for early versions of the TLIB model through November 1988.

Table 6--TLIB model: U.S. beef sector

Item	Production	Consumption
	Dol./mt	
Initial price	1,893	5,116
Traded price	2,091	2,091
Gap	-198	-3,025
Subsidy equivalent	215	-44
Margin	-413	2,981
Liberalized traded price	2,461	2,461
Liberalized domestic price	2,048	5,442

difference between the traded price and the initial price is defined as "cnconst." For U.S. beef, prconst is -$198, and cnconst is -$3,025. The PSE/CSE should help account for the gap between the traded and initial prices. However, the PSE in the model is $215, a positive amount. This PSE value implies the difference between the new producer and traded prices will equal a margin of -$413 with liberalization. The difference between the liberalized producer price ($2,048) and the new traded price ($2,461) equals this amount. The CSE in the model is -$44. Because the CSE is negative, it helps to explain a small portion of the cnconst of -$3,025. Nonetheless, the margin amount will equal $2,981. As the table shows, the difference between the liberalized consumer price ($5,442) and the new traded price ($2,461) equals this amount.

A problem with this price initialization scheme is that there is no clear meaning to the notion of the margin. The margin acts as a residual. It may include the various portions of the PSE or CSE not affecting production or consumption, respectively, plus technical marketing and/or processing margins and quality differences. Removing the full value of the PSE and/or CSE in a liberalization scenario reintroduces the problem of not knowing the effect of the components on production/consumption. The changes of quantities supplied and demanded are still derived through the own price supply and demand elasticities. The degree to which the fixed margin concept compensates for the unknown weighting scheme is also unknown.

The following example is meant to clarify this matter. Assume that technical marketing and processing margins are zero. Equation 8 is a supply equation. The quantity supplied is a function of an input and output price:

$$Q = a*(P_I - CSE_I)^{-b}*(P_O + PSE_O)^c \qquad (8)$$

where b and c are the input and output supply elasticities, and the following are defined:

P_O = TRADED PRICE OF OUTPUT

P_I = INPUT PRICE

PSE_O = UNIT VALUE OF DIRECT PAYMENT

CSE_I = UNIT INPUT SUBSIDY

$PSE = PSE_O + CSE_I$

Because the input supply elasticity is unknown, SWOPSIM models the supply equation as follows:

$$Q = a*(P_O + PSE_O + CSE_I + RESIDUAL)^c \tag{9}$$

Setting equations 8 and 9 equal to each other, and solving for the RESIDUAL produces the following:

$$RESIDUAL = (P_O + PSE_O)*((P_I - CSE_I)^{\frac{-b}{c}} - 1) - CSE_I \tag{10}$$

There is no useful interpretation to this expression. The market price is equal to the following:

$$PCED = P_O + CSE_I + RESIDUAL \tag{11}$$

In turn, the price used in SWOPSIM is the producer incentive price or the following:

$$PVOR = PCED + PSE_O \tag{12}$$

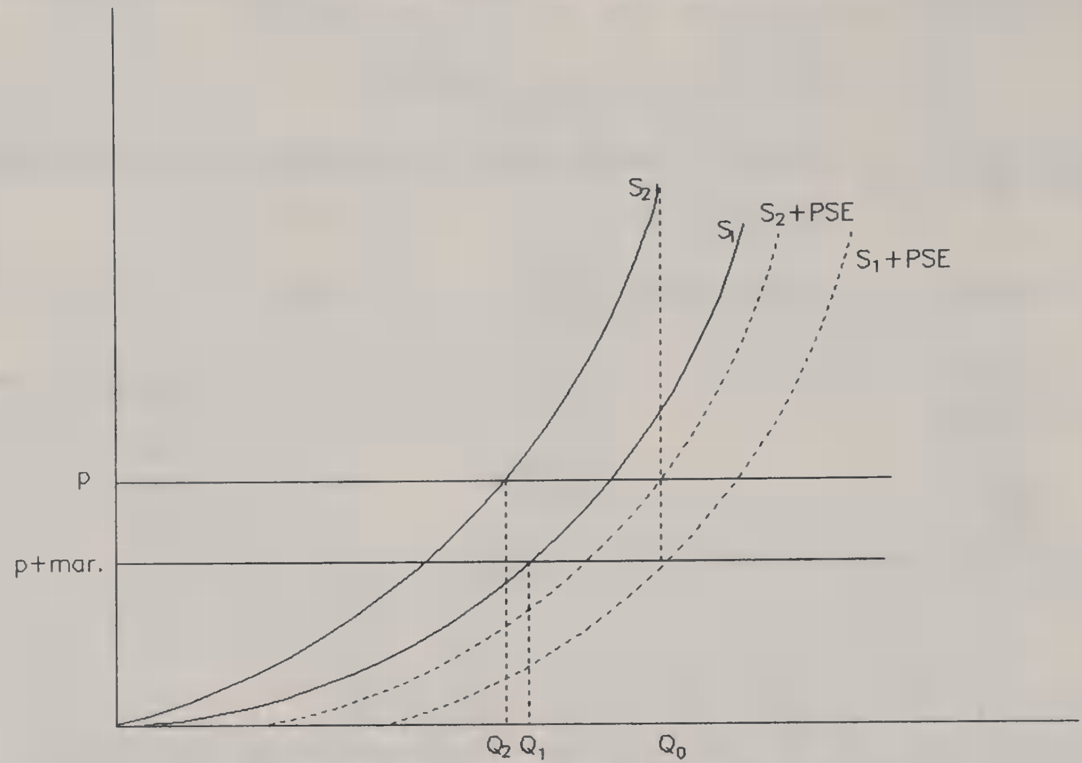
An alternative consistent with PSE/CSE methodology is to initialize on the sum of the traded price, the PSE, and any known margin component dealing with marketing or processing (P_0+ PSE). The full value of the PSE/CSE wedge is incorporated into the difference between the traded price and the domestic price. When it is removed, domestic producer and consumer prices converge to the traded price adjusted for technically based margins.

A problem with this approach is that it assumes that the traded price is known for all countries. What is done for countries where the traded price is missing is to set it equal to the world reference price. This method, however, ignores transport costs and, more importantly, product quality differences between nations. In the case where the domestic market price is known, one can impute a traded price value by subtracting the full value of the PSE from the producer incentive price used in initialization. This method is equivalent to removing the market support component of the PSE from the market producer price to arrive at the traded price.

SWOPSIM preserves the ratio of the dollar-traded price to the world reference price throughout the liberalization scenarios. For example, if the U.S. market price of wheat is \$86/mt, the producer incentive price will be \$86 plus the unit value of the PSE of \$100/mt less the market support component of \$10/mt, or \$176/mt. The traded price equals \$176/mt less \$100/mt, or \$76/mt. If the world reference price is \$115/mt, then the liberalized producer price will equal 66 percent (that is,(\$76/\$115)*100) of the liberalized world price. In a SWOPSIM run described below, a liberalized wheat price is computed to be \$151.75/mt, but the U.S. producer price is only \$100.60/mt.

The choice of initialization can influence the liberalization results. Consider figure 12 for the quantity supplied of a good in a small country. S1 and S1+PSE represent the undistorted and subsidy-laden supply curves (respectively) when a (negative) margin is incorporated into the initialization. Initial quantity supplied is Q0, and liberalized quantity supplied is Q1. S2 and S2+PSE represent the undistorted and subsidy-laden supply curves (respectively) when initialization incorporates the full value of the PSE. The initial quantity

Figure 12--Price initialization



supplied is Q0, but the liberalized quantity supplied is Q2, which is a slightly smaller amount than the Q1 when the initialization scheme is different.

It is not clear whether the choice of the initialization scheme really matters. As an experiment, the small 11-country version of TLIB (called ST86) was initialized in three different ways and a full industrial market economies' (IME) liberalization scenario was run for each of the initializations.[17] Figure 13 shows the implied supply curve shifts corresponding to three possible producer price initializations. Column G shows the shifts when the producer incentive price (PRPRICE) equals the market price plus the unit value of direct payments (that is, income support). Column H corresponds to a producer incentive price equal to the market price plus PSE less market price support. Column I corresponds to the border price plus the PSE.

The higher the producer incentive price is, given a fixed PSE, the smaller the initial effect of a reduction of the PSE. The commodities affected the most are the U.S. program commodities: wheat, corn, other coarse grain, and rice. If the initialized prices equal the market prices plus direct payments, removal of the PSE's implies a substantial backward shift in the supply curves: 47 percent for wheat, 30 percent for corn, 53 percent for other coarse grain, and 40 percent for rice. If the initialized prices equal the border prices plus the full value of the PSE's, the backward shifts are much less: 31 percent for wheat, 19 percent for corn, 25 percent for other coarse grain, and 26 percent for wheat. The shifts corresponding to the market price plus PSE less market price support fall in between the two extremes.

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[17] There are seven industrialized market economy categories in ST86: the United States, Canada, the European Community, Other Western Europe, Japan, Australia, and New Zealand.

A similar type of analysis can be run for consumption. Figure 14 shows three alternatives. The first alternative is to use consumer prices supplied by ERS analysts. Column C lists the prices supplied by ERS analysts and column G shows the implied shift of the demand curve when consumer support is removed. A second alternative is to use the producer market price. Setting the consumer price equal to the producer market price allows the modeling of processor purchasing behavior fairly low in the marketing chain. (A drawback to this specification, however, is that the demand elasticities used in TLIB typically relate to final demand. This is especially true for livestock and dairy demand.) Column D lists the producer market price, and column H lists the corresponding shift. A third alternative is to let the consumer price equal the traded price less the CSE plus an imputed margin derived from farm-to-retail spreads calculated by ERS (<u>1</u>). Column E lists this consumer price, and column I shows the implied demand curve shift. Comparison of the demand shifts does not yield the same type of pattern exhibited on the producer side. The shifts corresponding to the producer market price (column H) are greater than the others in 6 instances, the same in 12, undefined in 1, and merely different in 2. The shifts corresponding to the first and third consumer prices are more similar to each other.

Figure 13--U.S. TLIB supply shifts and price initialization

	A	B	C	D	E	F	G	H	I
1	ST86-US	SUPPLY	PRPRICE	PRPRICE	PRPRICE	PSE	SSHIFT	SSHIFT	SSHIFT
2		ELAST	PM+DP	PM+PSE-MS	PT+PSE		PM+DP	PM+PSE-MS	PT+PSE
3	ST86-US			($/MT)					
4	BF	0.65	1893	2064	2306	215	-0.075	-0.069	-0.062
5	PK	1	1494	1611	2458	117	-.079	-.073	-.048
6	ML	.8	2902	3337	2477	447	-.125	-.109	-.147
7	PM	.65	1049	1131	1262	179	-.115	-.106	-.095
8	PE	.55	864	913	2194	49	-.031	-.030	-.012
9	DM	.5	270	343	340	28	-.053	-.042	-.042
10	DB	.5	3509	3509	3509	1461	-.236	-.236	-.236
11	DC	.64	3730	3730	3730	986	-.178	-.178	-.178
12	DP	.71	2307	2307	2307	323	-.102	-.102	-.102
13	WH	.6	152	176	215	100	-.473	-.395	-.313
14	CN	.48	91	107	135	48	-.303	-.249	-.190
15	CG	.6	69	93	131	49	-.528	-.364	-.246
16	RI	.4	325	356	444	234	-.399	-.348	-.259
17	SB	.6	171	189	226	18	-.065	-.058	-.049
18	SM	.3	184	184	184	0	.000	.000	.000
19	SO	.13	342	342	342	0	.000	.000	.000
20	OS	.55	240	298	382	58	-.142	-.112	-.087
21	OM	.3	166	166	166	0	.000	.000	.000
22	OO	.44	569	569	569	0	.000	.000	.000
23	CT	.74	1907	2042	1946	890	-.372	-.345	-.364
24	SU	.5	274	531	390	257	-.754	-.282	-.416
25	TB	.25	3946	3946	3946	340	-.022	-.022	-.022
26									
27	PM=MARKET PRICE								
28	DP=DIRECT PAYMENT								
29	MS=MARKET SUPPORT								
30	PT=BORDER PRICE								

Figure 14 - U.S. TLIB demand shifts and price initialization

	A	B	C	D	E	F	G	H	I
32	ST86-US	DEMAND	CNPRICE	CNPRICE	CNPRICE	CSE	DSHIFT	DSHIFT	DSHIFT
33		ELAST	RET/WHS	PM	PT-CSE+MAR		RET/WHS	PM	PT-CSE
34	ST86-US			($/MT)					+MAR
35	BF	-.7	5116	1893	3882	-44	-.006	-.017	-.008
36	PK	-.86	2341	1494	4682	0	.000	.000	.000
37	ML	-.7	2042	2902	4085	-12	-.004	-.003	-.002
38	PM	-.56	1887	1049	2146	-97	-.030	-.056	-.026
39	PE	-.35	2125	864	3542	20	.003	.008	.002
40	DM	-.23	278	278	623	0	.000	.000	.000
41	DB	-.63	3916	2048	4531	-1577	-.383	-1.523	-.309
42	DC	-.6	5879	2744	5300	-966	-.114	-.297	-.128
43	DP	-.65	1373	1984	3347	694	-.580	-.323	-.163
44	WH	-.35	100	86	178	-10	-.037	-.043	-.020
45	CN	-.21	87	59	97	0	.000	.000	.000
46	CG	-.47	73	55	104	-11	-.081	-.113	-.055
47	RI	-.25	210	122	420	0	.000	.000	.000
48	SB	-.42	208	171	219	0	.000	.000	.000
49	SM	-.31	184	184	230	0	.000	.000	.000
50	SO	-.37	342	342	684	0	.000	.000	.000
51	OS	-.32	324	240	360	0	.000	.000	.000
52	OM	-.9	166	166	208	0	.000	.000	.000
53	OO	-.69	569	569	1138	0	.000	.000	.000
54	CT	-.2	1056	1152	2112	0	.000	.000	.000
55	SU	-.24	628	274	1096	-415	-.296	ERROR	-.121
56	TB	-.2	3606	3606	7212	0	.000	.000	.000
57									
58	PM = MARKET PRICE								
59	RET/WHS = RETAIL OR WHOLESALE								
60	PT = BORDER PRICE								
61	MAR = MARGIN								

Three liberalization scenarios were run. The first initializes on the market price plus direct payment for the producer and on the ERS analyst price for the consumer. The second initializes on the market price plus the PSE less market price support for the producer and on the ERS analyst price for the consumer. The third initializes on the traded price plus the PSE for the producer and on the traded price less the CSE plus the computed margin for the consumer. The consumer price equal to the producer market price was left out of the reported results. Liberalization consists of removing all support in the form of PSE's and CSE's for the IME countries. There is an adjustment for the removal of set-aside provisions; details are discussed in the preceding section of this report.

Figure 15 shows a comparison of IME liberalization results for changes in U.S. supply and in U.S. trade in each commodity. The first two runs give basically the same results for both production and trade.[18] Reduction of support for

[18] The similarity of results holds for almost all commodities in all other regions in the model.

Figure 15--Comparison of liberalization results:
Changes in U.S. supply and trade

	A	B	C	D	E	F	G	H
1	ST86-US							
2		CHANGE IN SUPPLY				CHANGE IN TRADE		
3	COMMODITY	RUN #1	RUN #2	RUN #3		RUN #1	RUN #2	RUN #3
4	BF	366	381	336		794	821	1399
5	PK	107	-9	81		618	348	627
6	ML	-11	13	4		2	49	27
7	PM	-113	-114	-134		31	-2	15
8	PE	-43	-101	-72		31	-56	-4
9	DM	-943	-824	-763		0	0	0
10	DB	67	170	56		58	156	37
11	DC	-147	-280	-133		-136	-303	-136
12	DP	103	272	86		143	371	101
13	WH	-1436	-1673	2424		-299	-784	3401
14	CN	-3790	-4155	1977		1818	1419	7371
15	CG	-7940	-6497	-1821		-9711	-9084	-3916
16	RI	-158	-205	285		-72	-152	356
17	SB	1005	1106	968		951	1100	942
18	SM	5	-39	-52		-578	-443	-599
19	SO	1	-9	-12		37	19	28
20	OS	870	828	365		1039	985	445
21	OM	-81	-73	-38		-47	-14	-27
22	OO	-35	-32	-17		14	22	21
23	CT	-183	-127	-160		-173	-118	-149
24	SU	-2694	-913	-1575		-4394	-2370	-3652
25	TB	-4	-4	-5		-1	-1	-2
26								
27		RUN #1						
28		PRODUCER PRICE=MARKET PRICE+DIRECT PAYMENT						
29		CONSUMER PRICE=ERS ANALYST						
30		RUN #2						
31		PRODUCER PRICE=MARKET PRICE+(PSE-MARKET SUPPORT)						
32		CONSUMER PRICE=ERS ANALYST						
33		RUN #3						
34		PRODUCER PRICE=BORDER PRICE+PSE						
35		CONSUMER PRICE=BORDER PRICE-CSE+COMPUTED MARGIN						

wheat, corn, and other coarse grains implies production losses after adjustment to a liberalized producing and trading environment. Wheat and coarse grain exports fall and corn exports increase very modestly. The results of the third run for the program commodities differ substantially from the first two runs. Instead of decreasing, the production of wheat, corn, and rice increase relative to the base by 4.3 percent, 0.9 percent, and 6.7 percent, respectively. Net exports of these commodities increase more than indicated in the other runs. The decrease in other coarse grain production is less (4.2 percent) than the first two runs (18.3 percent and 15 percent). Other coarse grain exports fall by less as well.

Comparison of these results shows that the price initialization issue is not a trivial one. The market price less market support should equal the analyst's

(actual or implied) reference price.[19] For the U.S. wheat example, the calculated border price is $76/mt while the reference price is $115/mt. Note, however, that the reference price is a U.S. gulf coast price. Presumably the $39 difference can be attributed to intermediate transport and processing costs. A problem exists in that the liberalized margin is equal to $51.15/mt (which is the new world price $151.75 less new U.S. producer price $100.60) instead of $39/mt. The solution would be to initialize at $176/mt (the market price plus PSE less market support) and keep the traded price at $115/mt. Removal of the $100/mt PSE with a "prconst" of $61/mt preserves the $39/mt differential. Although this procedure seems straightforward, it works for U.S. wheat because the price gap data is computed from the value of export enhancement bonuses. Otherwise, one would have to have explicit information regarding unit internal transport and processing costs.

Which method should be used to initialize the model? If the analyst uses the same reference price as used in the model, then the two methods (2 and 3) are equivalent. If the analyst uses a different reference price to calculate the market price component, the analyst may then account for international quality differences and international transport costs, but not internal transport and processing costs. Without explicitly modeling these costs, the likelihood is that the production estimate will be higher than it should be. Unless the analyst is willing to estimate these costs, a compromise solution is to run liberalization scenarios according to both methods, compare results, and make judgments according to the reasonableness of the model results.

In the U.S. example, the model was reinitialized with the producer incentive prices equalling the market prices plus PSE's less market support and the trade prices equalling the model reference prices. The supply changes for wheat, corn, other coarse grain, and rice were 230,000 mt, -1,779,000 mt, -4,818,000 mt, and 0 mt, respectively. These results fall about midway between results from runs 2 and 3 listed in figure 15. The same qualitative result holds for the net export numbers as well.

There is also the question of which consumption price to initialize on. There is a certain appeal to using the producer market price because this is the price which intermediate processors must pay as the product works its way up the processing chain to final consumption. As mentioned earlier, however, the demand elasticities used in the model typically relate to final consumer demand and not to intermediate demand. With the exception of certain feeds, soybeans, and other oilseeds where this method is followed, it should probably not be used. Farm-to-retail margins, if available, can be used to help remedy this problem. There are at least two possibilities: adjust the market producer price or the traded price less the CSE. If the latter price is used, then some adjustment for internal transport and already-completed processing may have to be taken into account. Using farm-to-retail margins is more advantageous than using retail prices of specific consumer products since farm-to-retail margins represent average unit value for the base product. Problems related to farm-to-retail margins are serious, however. The margins tend to vary over time, and they vary across countries. As in the case with production, it is probably best to initialize using both methods, and then compare results for any major

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[19] For U.S. wheat and other coarse grain, the unit values of export enhancement bonuses are used as proxies for all market price support. The traded price of $76/mt of wheat, therefore, is an imputed value.

inconsistencies.[20]

Conclusions

Although PSE's and CSE's are aggregate measures of support based on the income compensation principle, they have been used in the SWOPSIM modeling framework as price wedges. The problem is that the policy components which comprise the total PSE or CSE are assumed to all have the same effect on production or consumption, respectively. In other words, for a particular commodity, there is no distinction between the effect of differing policies on producer or consumer outcomes. Estimating the effects of differing policies is a formidable job given the myriad of policies which correspond to wide commodity and country coverage in the TLIB model.

One of the most basic problems involved in using PSE's and CSE's as price wedges is the issue of price initialization. Market prices do not necessarily reflect the total unit support given to a particular commodity. One solution is to add the unit value of those components of the PSE or CSE deemed not to be included in the market price to arrive at the producer or consumer incentive price. That portion of the gap between the incentive price and the border price not accounted for by the PSE or CSE is a residual margin that is preserved throughout the liberalization scenario. Although this solution does not seem unreasonable, in certain cases where the PSE forms a high percentage of the market price, unrealistically high (negative) margins are preserved in the model's solution. The resulting low producer prices imply levels of post-liberalization production that are unrealistically low.

One method of initialization consistent with the use of PSE's and CSE's as model price wedges is to add the full value of the support measure adjusted for known margins to the border price to arrive at the incentive price. Instead of the margin being calculated as a residual, the incentive price is a residual. Whatever amount of support is added to the sum of the border price and unit margin, that same amount is taken away when the full liberalization scenario is run. The difference between the border price and the producer and consumer price upon liberalization will be the margin supplied by country and commodity analysts.

A serious drawback to adjusting the border price is that in many cases the border price is not known. Using the world reference price as a country's border price ignores transport costs and possible qualitative differences between only roughly similar products. A possible solution to this problem is to calculate a border price which is consistent with at least the PSE concept. The producer incentive price is calculated by adjusting the market price by the unit value of the portion of the PSE not already reflected in the market price (that is, market price support). The border price is calculated as the sum of the incentive price and known margin less the full value of the PSE. As the model solves, percentage changes in the world reference price are transmitted to

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[20] For regions where there are no reported retail prices, the procedure has been to initialize on the reference price less the CSE. The implication of this discussion is that this price should be adjusted upward to reflect the farm-to-retail processing costs. Some judgment will have to be exercised because it is likely that good margin data are scarce for these regions.

a country's border price and from there to the producer and consumer incentive prices. The solution will show the difference between the border price and domestic incentive prices to be equal to the margins entered by the analyst. Although this adjustment method does not seem unreasonable, the difference between a country's border price and the world reference price is left unexplained.

Some adjustment to the PSE must be made when modeling trade liberalization in the context of acreage set-asides or mandatory production controls. The effect of the restrictions can be modeled as tax equivalents. The size of the tax equivalents is a function of what production would have been without the set-aside and the own price supply elasticity. The size of the tax equivalent for both program commodities and perhaps some nonprogram commodities can be influenced by cross-compliance requirements and production substitution possibilities. The tax equivalents reduce the price wedge and should therefore affect the initialization price. An alternative to the tax equivalent method is to directly shift supply curves. This procedure is preferable because it does not involve re-initialization of the model when performing sensitivity analysis. However, the tax equivalents should be used when examining welfare implications of set-aside removal. This examination will involve some simple programming changes of welfare changes in the SWOPSIM framework.[21]

An analyst should consider the type of policies which underlie the aggregate PSE and CSE figures. Policies such as target prices, loan rates, export restitutions, variable levies, quantitative restrictions, and others are only imperfectly modeled within the SWOPSIM framework. In some cases, specific forms of policy may not matter all that much if a 100-percent liberalization scenario is being run. However, if a partial liberalization is being examined, some attention to the types of policies being removed and those remaining in place is in order. Analysts can endogenize the level of support to correspond to the way they believe is appropriate. Alternatively, price transmission elasticities within SWOPSIM can be manipulated to reflect the degree to which domestic agriculture is influenced by international trade reform. A spreadsheet modeling framework such as SWOPSIM lends itself well to analyst-generated adjustments.

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[21] These changes have been made in the default producer surplus formulas in SWOPSIM as of November 1988.

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UNITED STATES DEPARTMENT OF AGRICULTURE
ECONOMIC RESEARCH SERVICE
1301 NEW YORK AVENUE, NW.
WASHINGTON, DC 20005-4788